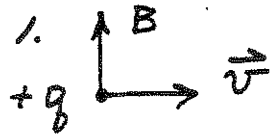
FORCE ON A CHARGE MOVING IN A MAGNETIC FIELD. $\vec{F}_B = q\vec{v} \times \vec{B}$. USE THE RIGHT-HAND RULE TO FIND THE DIRECTION OF THE $\vec{F}_B$. ↑ ↓ → ← ⊙ ⊗ NONE.

1. 

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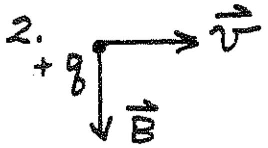
2. 

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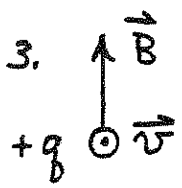
3. 

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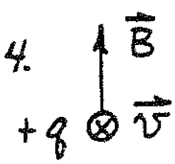
4. 

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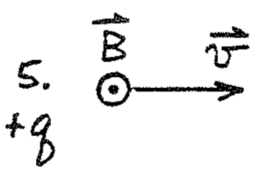
5. 

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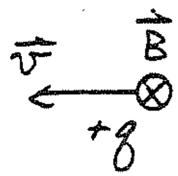
6. 

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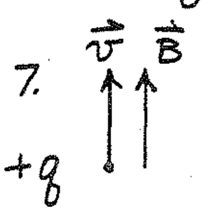
7. 

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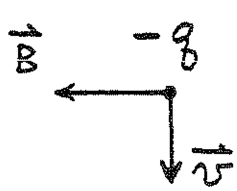
8. 

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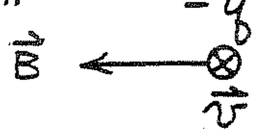
9. 

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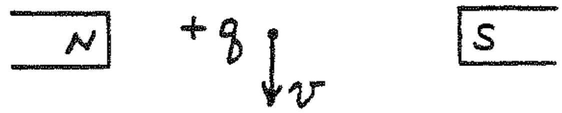
10. 

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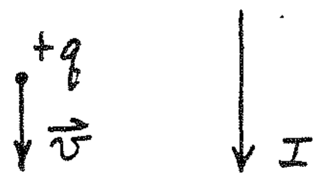
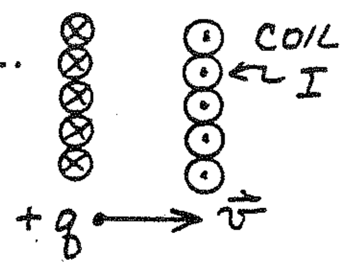
11. ____ 

12. 

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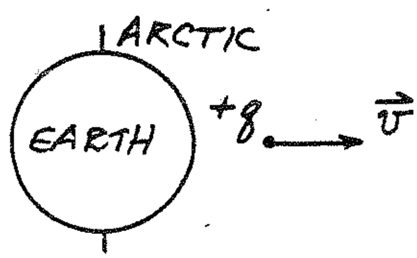
13. 

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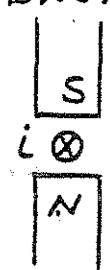
FIND THE DIRECTION OF THE MAGNETIC FORCE ON i.

14. 

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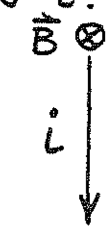
15. 

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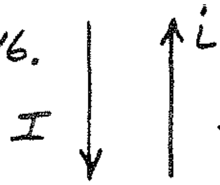
16. 

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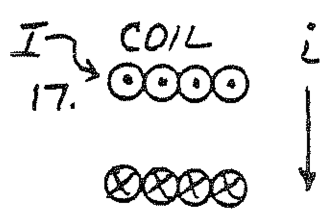
17. 

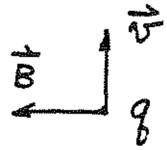
____

ANSWERS: ⊙, ⊗, ←, →, ↓, ↓, NONE, ⊙, ↓, ⊙, →, ⊗, ⊙, →, →, →, ⊙

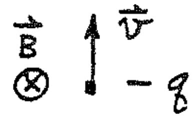
LORENTZ'S LAW FOR MAGNETIC FORCES OR A PAGE OF CHIROPRACTIC EXERCISES.

IN THE BLANK, PUT A "→, ←, ↑, ↓, ⊗, ⊙, OR ZERO" TO INDICATE THE DIRECTION OF THE F_B ON q OR i.

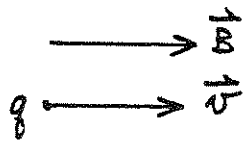
a) ______



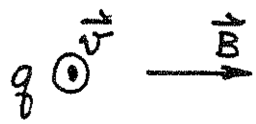
b) ______



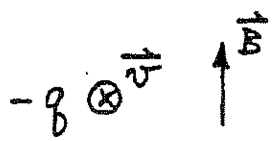
c) ______



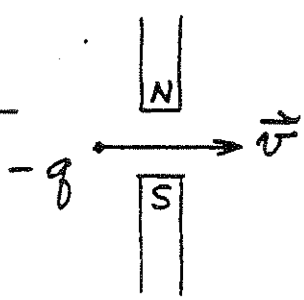
d) ______



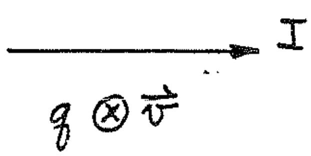
e) ______



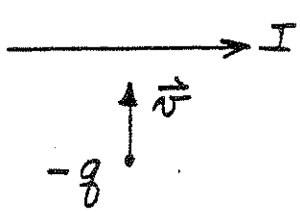
f) ______



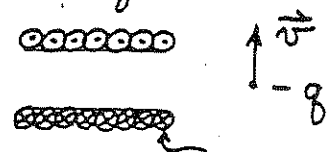
g) ______ F_B ON q



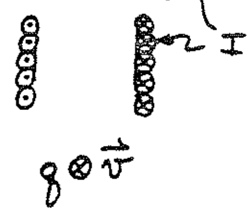
h) ______ F_B ON $-q$



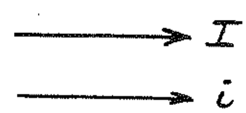
i) ______



j) ______

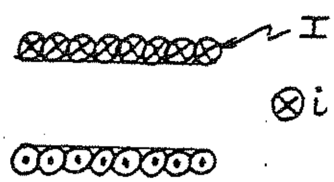


k) ______ F ON i

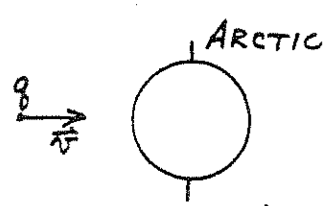


l) ______

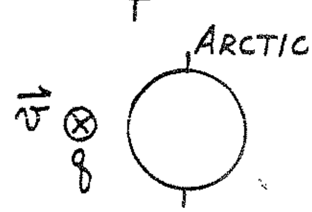
m) ______ FORCE ON i



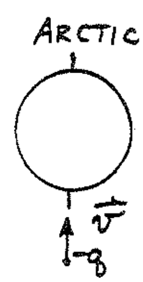
n) ______



o) ______



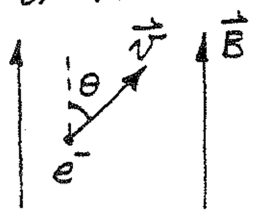
p) ______



LORENTZ FORCE LAW: $\vec{F} = \vec{F}_{ELECTRIC} + \vec{F}_{MAGNETIC}$

$$\vec{F} = q\vec{E} + q\vec{v} \times \vec{B} = q\vec{E} + i\vec{l} \times \vec{B}$$

1. DETERMINE THE MAGNITUDE AND DIRECTION OF THE FORCE EXERTED ON THE ELECTRON.



$B = 3\times10^{-4}$ T

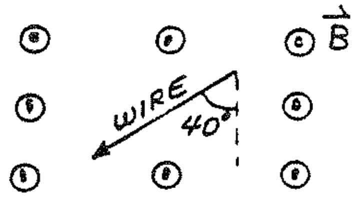
$\theta = 50^\circ$

$v = 2\times10^{5}$ m/s

$q = 1.60\times10^{-19}$ C

(7.354×10^{-18} N, INTO THE PAPER)

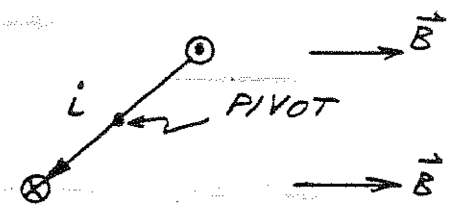
2. DETERMINE THE MAGNITUDE AND DIRECTION OF THE FORCE WHICH IS EXERTED ON THE WIRE.



B = .1 T WIRE LENGTH = 3 m CURRENT = .5 AMP

(.15 N, 50° WEST OF NORTH)

3. WE ARE LOOKING DOWN ON A SQUARE LOOP OF WIRE WHICH IS SUPPORTED ON A PIVOT.



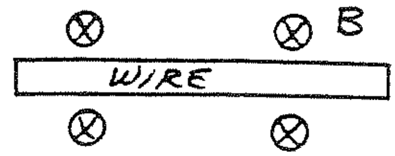
A) WHICH WAY WILL THE LOOP ROTATE?

B) DRAW THE LOOP AFTER IT REACHES EQUILIBRIUM.

C) B = 2 T, i = .5 A, THE LENGTH OF ONE SIDE OF THE LOOP IS .3 m. FIND THE MAGNITUDE OF THE FORCE ON ONE EDGE OF THE LOOP WHEN IT IS AT THE EQUILIBRIUM POSITION.

(.3 N, OUTWARD)

4. A WIRE OF MASS .024 KG AND LENGTH .75 m HOVERS IN A MAGNETIC FIELD OF STRENGTH .04 TESLA.



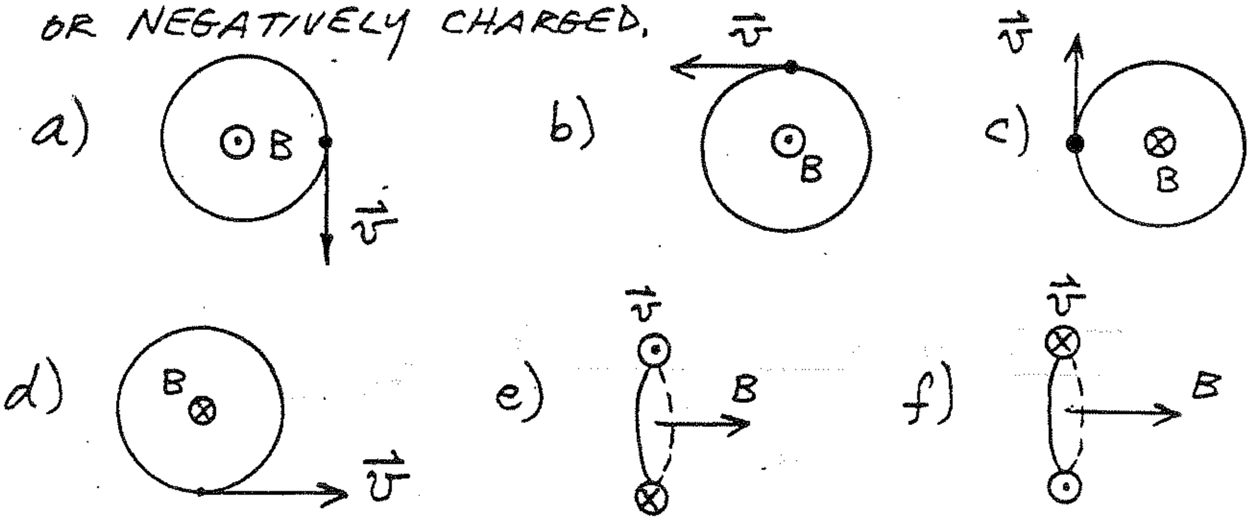
↑ $F_B = iLB$

↓ $F_g = mg$

A) FIND THE DIRECTION OF THE CURRENT IN THE WIRE. (FROM LEFT TO RIGHT)

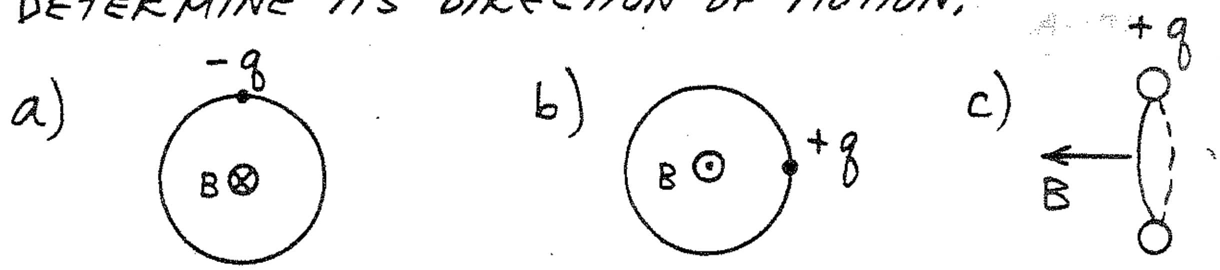
B) FIND THE CURRENT. (8 AMPS)

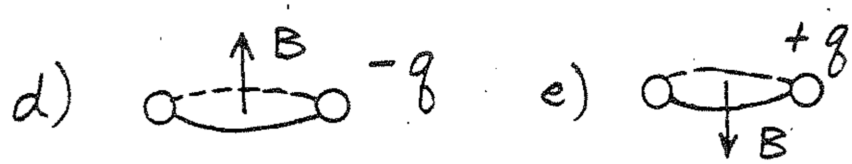
5. A CHARGED PARTICLE IS TRAPPED IN CIRCULAR MOTION BETWEEN THE POLES OF A MAGNET. DETERMINE WHETHER IT IS POSITIVELY CHARGED OR NEGATIVELY CHARGED.



ANSWERS: +, −, −, +, −, +

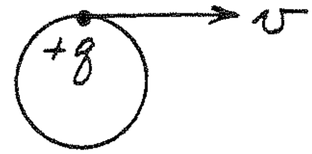
6. A CHARGED PARTICLE IS TRAPPED IN CIRCULAR MOTION BETWEEN THE POLES OF A MAGNET. DETERMINE ITS DIRECTION OF MOTION.





ANSWERS: CW, CW, ⊙⊗, ⊙⊗, ⊙⊗

7. A PROTON WITH MASS 1.67×10^{-27} KG AND CHARGE 1.6×10^{-19} C IS TRAPPED IN CIRCULAR MOTION BETWEEN THE POLES OF A MAGNET WHOSE FIELD IS .4 TESLA. THE RADIUS OF THE PROTON'S ORBIT IS .07 m.



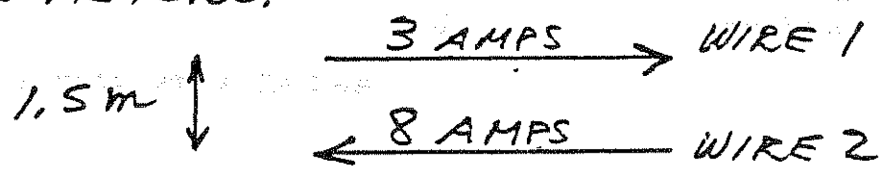
A) FIND THE DIRECTION OF THE MAGNETIC FIELD.

B) FIND THE SPEED, PERIOD, FREQUENCY AND ANGULAR FREQUENCY OF THE PROTON.

($\odot$, 2.68×10^{6} m/s, 1.64×10^{-7} SEC, 6.1×10^{6} Hz, 3.83×10^{7} sec^{-1})

8. AN ELECTRON IS TRAPPED IN A CIRCULAR ORBIT BETWEEN THE POLES OF A MAGNET OF STRENGTH .7 TESLA. IT ANGULAR FREQUENCY IS 1.2294×10^{11} SEC^{-1}. FIND THE VALUE FOR THE RATIO OF THE CHARGE OF THE ELECTRON DIVIDED BY ITS MASS. (1.7563×10^{11} C/KG)

9. TWO PARALLEL WIRES CARRY CURRENT IN OPPOSITE DIRECTIONS. BOTH HAVE LENGTH OF FIVE METERS.



A) SKETCH THE MAGNETIC FIELD PRODUCED BY WIRE 1.

B) FIND B_1 AT THE LOCATION OF WIRE 2.

C) USE THE RIGHT HAND RULE TO FIND THE DIRECTION OF THE FORCE ON WIRE 2.

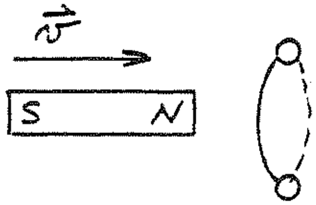
D) FIND THE FORCE EXERTED ON WIRE 2.

E) USE NEWTON'S THIRD LAW TO FIND THE MAGNITUDE AND DIRECTION OF THE FORCE ON WIRE 1. (4×10^{-7} T, 1.6×10^{-5} N, 1.6×10^{-5} N)

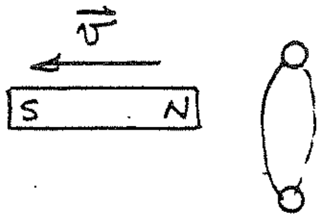
FARADAY AND LENZ GET TOGETHER TO MAKE JUICE

ON THE LOOP, INDICATE THE DIRECTION OF THE INDUCED CURRENT.

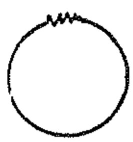
a)



b)

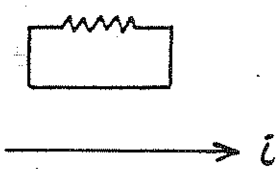


c)



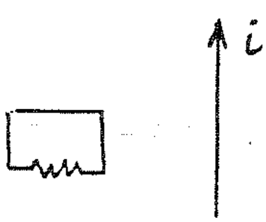
JAM A S-POLE INTO THE PAGE

d)



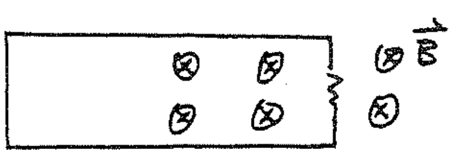
i IS INCREASING

e)



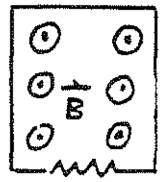
i IS DECREASING

f)



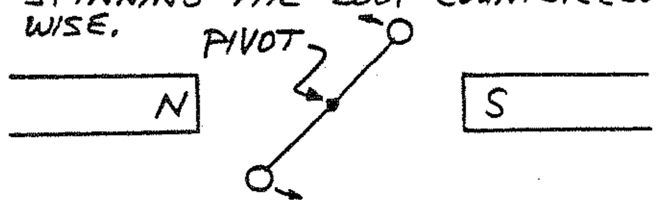
THE LOOP IS PUSHED TO THE RIGHT INTO THE MAGNETIC FIELD

g)

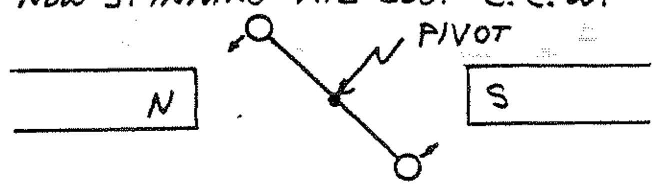


THE LOOP IS PULLED DOWN OUT OF THE MAGNETIC FIELD.

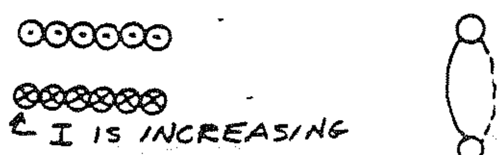
h) WE ARE LOOKING DOWN ON A LOOP OF WIRE WHICH CAN SPIN IN A $\vec{B}$ FIELD. INITIALLY, THE LOOP WAS PARALLEL TO THE FIELD SO THAT IT POSSESSED NO FLUX. WE ARE SPINNING THE LOOP COUNTERCLOCKWISE.



i) INITIALLY, THE LOOP WAS PERPENDICULAR TO THE $\vec{B}$ FIELD. WE ARE NOW SPINNING THE LOOP C.C.W.

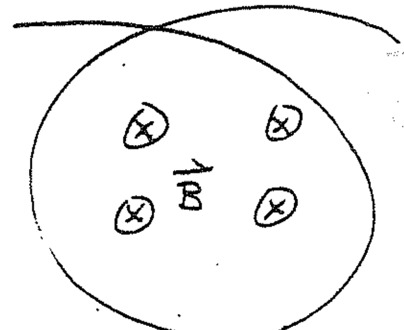


j)



I IS INCREASING IN THE COIL

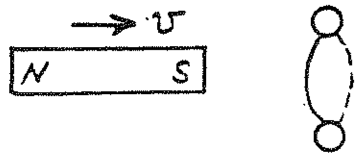
k)



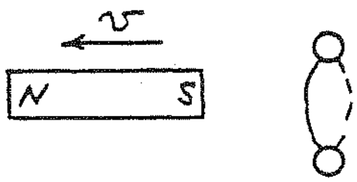
WE PULL ON BOTH ENDS OF THE WIRE AND STRANGLE THE $\vec{B}$ FIELD.

LENZ'S LAW: ON THE LOOP, INDICATE THE DIRECTION OF THE INDUCED CURRENT.

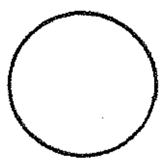
a)



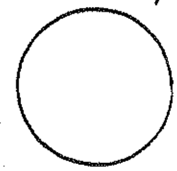
b)



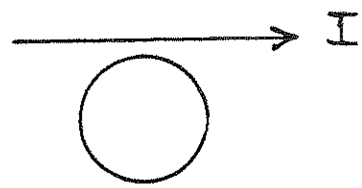
c) A N-POLE IS JAMMED INTO THE PAPER TOWARD THE LOOP.



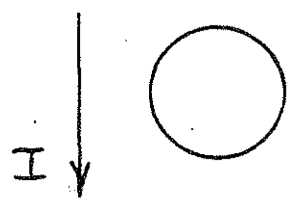
D) A N-POLE ABOVE THE PAPER IS PULLED AWAY FROM THE LOOP.



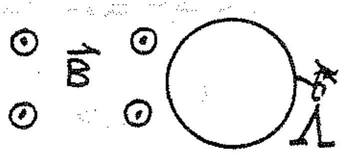
E) I IS INCREASING



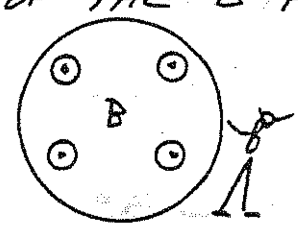
F) I IS DECREASING



G) THE LOOP IS PUSHED INTO THE $\vec{B}$ FIELD.



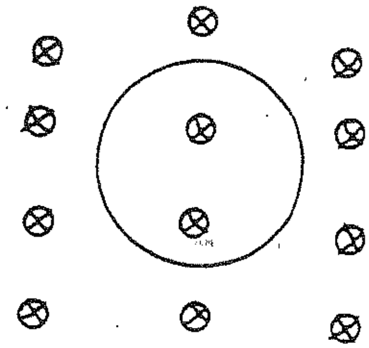
H) THE LOOP IS PULLED OUT OF THE $\vec{B}$ FIELD.



FARADAY'S LAW OF ELECTROMAGNETIC INDUCTION

1. A CIRCULAR LOOP OF WIRE HAS A RESISTANCE OF 50 Ω AND AN AREA OF 2.5 m^2. AT WHAT RATE MUST THE MAGNETIC FIELD THROUGH THE LOOP CHANGE, SO THAT THE CURRENT IN THE LOOP IS 2 AMPS?
(40 TESLA/SEC)

2. A WIRE OF RESISTANCE 50 Ω IS BENT TO FORM A LOOP OF AREA .3 m^2. THE MAGNETIC FIELD VARIES AS $B = 4t^2 + 8t + 5$



A) IN WHAT DIRECTION IS THE INDUCED CURRENT?

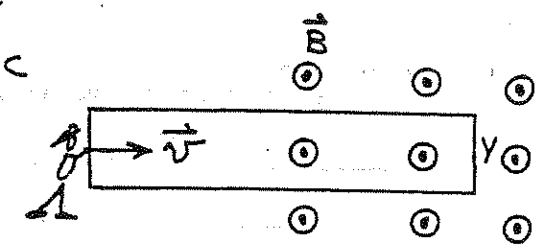
B) CALCULATE THE INDUCED VOLTAGE AT TIME $t = 12$ SEC. (31.2 V)

C) CALCULATE THE CURRENT IN THE LOOP AT $t = 12$ SEC. (.624 A)

3. A CONDUCTING, RECTANGULAR LOOP IS PUSHED INTO A MAGNETIC FIELD AS SHOWN.

$v = 3$ m/s $Y = 2$ m

$B = .6$ T $R_{LOOP} = 50\,\Omega$



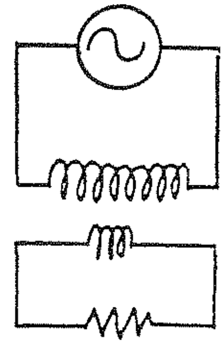
A) IN WHICH DIRECTION IS THE INDUCED CURRENT?

B) CALCULATE THE INDUCED VOLTAGE, INDUCED CURRENT AND THE POWER DISSIPATED IN THE RESISTANCE. (3.6 V, 72 mA, 259 mW)

C) CALCULATE THE FORCE REQUIRED TO PUSH THE BAR TO THE RIGHT. RECALL: $\vec{F}_{MAGNETIC} = i\vec{\ell} \times \vec{B}$ (.0864 N)

D) CALCULATE THE POWER SUPPLIED BY THE SCIENTIST. RECALL: POWER = WORK / TIME = $F \cdot d/t = F \cdot v$ (259 mW)

TRANSFORMERS



1. A TRANSFORMER HAS 2000 TURNS ON ITS PRIMARY COIL AND 50 TURNS ON ITS SECONDARY. THE PRIMARY COIL IS CONNECTED TO AN AC GENERATOR WHOSE EMF IS 120 V. THE SECONDARY COIL IS CONNECTED TO A LIGHT BULB WHOSE RESISTANCE IS .6 Ω.

A) CALCULATE THE EMF OF THE SECONARY COIL. (3 V)
B) FIND THE CURRENT THROUGH THE BULB. (5 A)
C) FIND THE POWER DISSIPATED BY THE BULB. (15 W)
D) WHAT POWER AND CURRENT IS SUPPLIED BY THE GENERATOR? (15 W, .125 A)

2. A TRANSMISSION LINE BETWEEN A POWER STATION AND A FACTORY HAS A RESISTANCE OF .1 Ω IN EACH OF THE TWO WIRES. A CURRENT OF 200 A IS DELIVERED AT 100 V TO THE FACTORY. CALCULATE:

A) THE POWER DELIVERED TO THE FACTORY. (20,000 W)
B) THE POWER WASTED TO HEAT BOTH WIRES. (8000 W)
C) THE TOTAL POWER GENERATED BY SAN ONOFRE. (28,000 W)

3. OVER THE SAME WIRES, THE POWER STATION NOW DELIVERS 20,000 WATTS TO THE FACTORY AT 1000 V. FIND:

A) THE CURRENT IN THE TWO WIRES. (20 A)
B) THE POWER WASTED TO HEAT THESE WIRES. (80 W)
C) THE TOTAL POWER GENERATED BY SAN ONOFRE TO SUPPLY THE FACTORY. (20,080 WATTS)

A SAVINGS OF 7920 WATTS OF POWER!

Name ______________________________ Hour ______

Magnetism Worksheet One

1. A proton is moving at right angles to a magnetic field of 2 T. What speed does the proton have if the magnetic force on it has a magnitude of 6×10^{-11} N?

2. A proton moves at right angles to a magnetic field of 0.1 T with a speed of 2×10^{7} m/s. Find the magnitude of the acceleration of the proton?

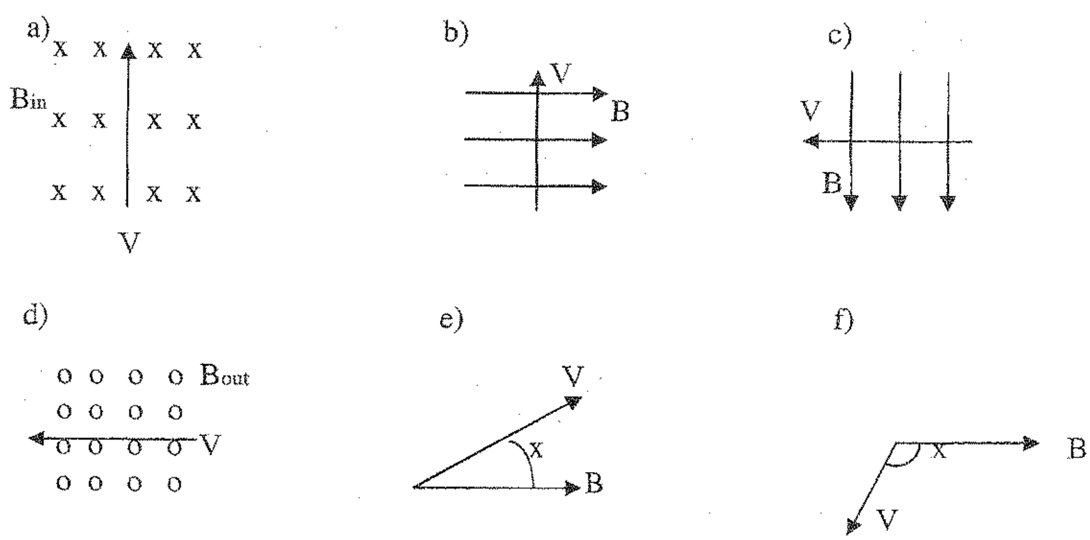
3. A proton travels with a speed 3×10^{6} m/s at an angle of 37^{0} with respect to the direction of a magnetic field of 0.3 T in the + y direction. What is
   (a) The magnitude of the magnetic force on the proton and

   (b) Its acceleration?

4. A Proton moves with a speed of 2.5×10^{6} m/s horizontally at right angles to a magnetic field.
   (a) What strength field is required to just balance the weight of the proton and keep it moving horizontally?

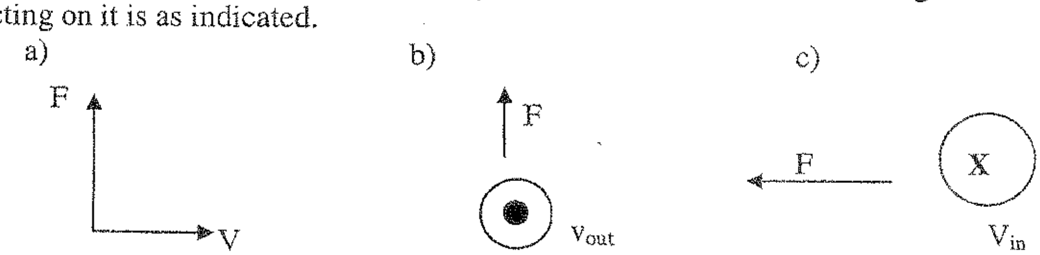
   (b) Should the direction of the magnetic field be in a horizontal or a vertical plane?

5. (a) Find the direction of the force on a proton moving as shown through the magnetic field as shown below



(b) Repeat part (a) assuming the moving particle is an electron.

6. Find the direction of the magnetic field on the positively charged particle moving in the various situations shown in drawings below if the direction of the magnetic force acting on it is as indicated.



Name____Date__________Hour___________

Magnetism Worksheet Two

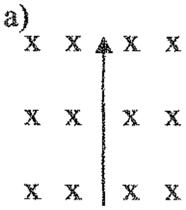
1. Calculate the force on a 2-m length of conductor carrying a current of 10 A in a region where a uniform magnetic field has a magnitude of 1.2 T and is directed perpendicular to the conductor.

2. A wire carries a current of 10 A in a direction of 30° with the respect to the direction of a magnetic field of strength 0.3 T. Find the magnetic force on a 5-m length of wire.

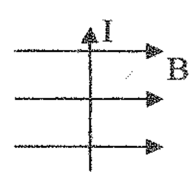
3. A vertical wire carries a current of 10 A directed upward at a location where the magnetic field of the Earth is horizontal and has a value of $5x10^{-5}$ T. IF the wire is 20 m long, find the magnitude and direction of the net magnetic force on it.

4. In the figure below, assume the Arrow in each case is a wire carrying current in the direction of the arrow. Find the direction of the magnetic force acting on the wire for each case.

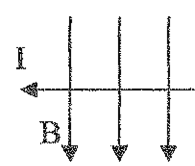
a)



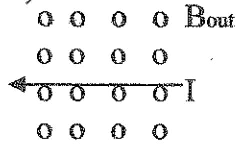
b)



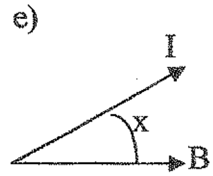
c)



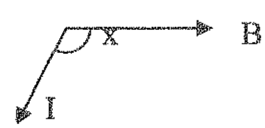
d)



e)



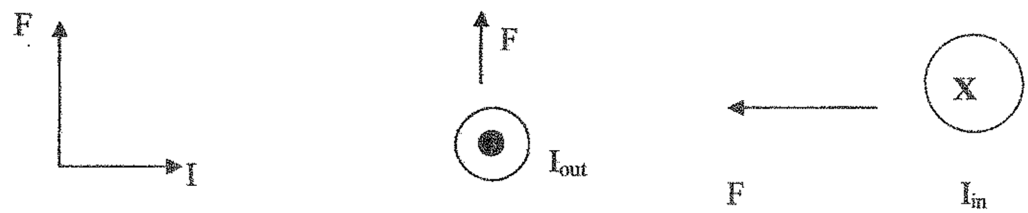
f)



Name________________________________ Date__________ Hour__________

5. In the figures below you are given the directions of the Force and Current in a wire. Find the direction of the magnetic field that will produce the magnetic force acting in each case.

a) b) c)



6. A wire with a mass of 5 g carries a 2-A current horizontally to the right. What are the direction and magnitude of the minimum magnetic field needed to lift this wire vertically upward?

7. A thin copper rod 1 m long has a mass of 50 g. what is the minimum current in the rod that will cause it to float in a magnetic field of 2 T?